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WATER TRANSFERS AND EFFICIENT MANAGEMENT OF DEVELOPED SUPPLIES

The efficient use of existing developed water supplies is an important element in successfully meeting Utah's future water needs. As competition for limited water supplies increases, the value of the existing water supplies also increases. This economic incentive leads to the transfer of water from one use to another. This chapter discusses the transfer of agricultural water to higher value uses as well as the following water-management strategies: agricultural water-use efficiency, conjunctive use of surface and ground water, aquifer storage and recovery, secondary water systems, cooperative water operating agreements, and water reuse.

AGRICULTURAL WATER TRANSFERS

The agriculture industry uses about 94 percent of the presently developed water in the basin. Municipal and industrial (M&I) uses account for the other six percent. Over the next 50 years agricultural uses are expected to drop to 89 percent and M&I uses to increase to 11 percent.

To date, not a lot of agricultural water has been converted to M&I use. Although there will be more in the future it is estimated that less than 5 percent (or 42,000 acre-feet) of the agricultural water would be converted over the next 50 years. The amount of agricultural water transferred to M&I use in the Bear River Basin will not be nearly as large as it will on the Wasatch Front. Most existing M&I systems in the basin have sufficient supplies to take them well beyond the year 2020 and many beyond 2050. Where existing supplies are inadequate to address the growth of the next 20 years, there are developable ground water and/or surface water sources. However, the development of surface water sources will likely require storage, making the new water expensive. In those cases, agricultural water transfers may prove to be a less expensive alternative compared to reservoir construction. In Box Elder County, the Bear River Water Conservancy District has acquired agricultural water in the Bothwell Pocket with the plans to convert this water to M&I use over time to meet the growth that is projected within the district.

Canal Maintenance in Box Elder County

AGRICULTURAL WATER-USE EFFICIENCY

This section discusses the major benefits of agricultural water-use efficiency, investigates some of the complexities that must be carefully considered in order for an efficiency project to be successful, and explores some of the irrigation methods that can be employed to increase agricultural water-use efficiency.

The Benefits of Water-Use Efficiency

The two major benefits of agricultural water-use efficiency are: (1) increased agricultural productivity and (2) improved water quality. In some instances, a third benefit of reduced stream diversion may also be realized. A short discussion of these benefits follows.

Increased Agricultural Productivity

Unless increasing the productivity of farms is a central focus of agricultural water-use efficiency, it will likely be difficult to gain the needed support of irrigators. Increasing agricultural productivity should be a high priority of any efficiency project. If a project fails to benefit the farmers who are expected to implement it, it will be difficult for the project to succeed.

Proper implementation of agricultural water-use efficiency typically increases crop yields 15 to 30 percent. Usually, irrigation system improvements first focus on the conveyance network, followed by on-farm improvements. A combination of both is necessary to maximize crop yields. This process may lead to increased depletions and ultimately reduce the return flow or ground water recharge as the crops use more water if greater productivity occurs.

Improved Water Quality

Improved irrigation efficiency can alleviate water quality problems. Reduced conveyance seepage losses will result in less salt pickup during subsurface transport. Reduced tailwater runoff (return flows) from irrigated fields will result in less soil erosion and less adsorbed phosphate fertilizer and insecticides being transported to downstream water bodies. Reduced deep percolation losses below the crop roots will also result in less transport of nitrate fertilizer to the ground water and less salt pickup.

Reduced Water Diversions

Reducing water diversions may be a benefit of agricultural water-use efficiency. Increased flows and improved quality in streams contribute to the health of riparian and wetland ecosystems, as well as fish and wildlife. However, for many irrigation systems, the water savings from on- and off-farm improvements will likely be stored in reservoirs for later use or used to satisfy any water deficiencies within the system. As a consequence, the full benefits of reduced diversions often affect only nearby stream segments and not the entire river system.

Irrigation Efficiency Methods

Once the appropriateness of efficiency measures in an area is determined, actual implementation of these measures can proceed. A host of irrigation efficiency technologies exist for almost any imaginable situation. Typical irrigation systems include storage reservoirs, conveyance through open canals or distribution piping, and on-farm application facilities and equipment. These systems can "lose" between 20 and 65 percent of the water diverted into them through seepage, evaporation, and transpiration from vegetation along the banks. Clearly, technology or management improvements can result in an increase of total system efficiency and a reduction in water loss.

The effectiveness of canal operations can be improved by moving from a fixed rotation schedule, which supplies water to irrigators at pre-specified times, to an on-demand scheduling, which supplies water when an irrigator requests. The amount of available storage dictates the degree to which on-demand scheduling can be implemented.

Automated canal operations, utilizing a network of water level and flow measurement devices as well as gate control mechanisms, provide the capability to monitor and manage entire irrigation systems through telemetry and computerized equipment. Remotely operated systems usually require considerable investments in technology and training


Flood Irrigation


Sprinkler Irrigation

personnel, but can realize substantial improvements in water efficiency for large irrigation systems.

Many on-farm application technologies also exist which have the potential to improve irrigation application efficiency. For example, pressurized irrigation can be employed, such as sprinkle irrigation (designed for 80 percent irrigation application efficiency) or trickle (drip) irrigation (designed for 95 percent application efficiency). The appropriateness for these methods depends upon local soils and topography, along with the farm economics and the type of crops to be grown.[1,2,3] At the present time there are very few places in the basin where drip irrigation would be practical.

Other technologies, such as laser land leveling and advances in surface irrigation hydraulics, make it possible for traditional surface (flood) irrigation to be as efficient and in some cases even more efficient than sprinkler irritation. With proper management laser land leveling can result in practically no tailwater runoff (return flows) and greatly reduce deep percolation.

Secondary or "Dual" Systems

Secondary water systems, also known as "dual" water systems, provide untreated water for outdoor uses, primarily lawn watering and gardening. These systems free up existing treated water for culinary uses. However, they do require the construction of an additional water conveyance infrastructure, and can be expensive, and consequently are less likely to be installed in developed areas of existing communities. In areas of new construction where an adequate secondary water supply exists, secondary systems are usually economical to install. Secondary water systems may also prove economical as a retrofit if the construction costs are less than the cost of enlarging the M&I system to meet future needs and the costs associated with treating the water to drinking water standards.

While there may be an economic incentive for building secondary water systems based on the cost of high quality treated water conserved, studies have shown that "secondary" systems do not promote overall water conservation. Since secondary water is seldom metered, consumers tend to use more of it when watering their lawns. Secondary systems should be metered when water quality allows. The development of a new inexpensive secondary water meter is needed and would enable the metering of secondary water systems and the implementation of pricing structures that would help control use.

Measurement

Measurement or metering of flows is important in both the agricultural setting and the urban setting. Accurate measurement of water use encourages conservation in several ways. Not only is each user assured a fair and equitable water distribution and a corresponding financial assessment, but it is also a more business-like way to operate a system and maintain records. When users pay according to the quantity of water they actually use, there is a built-in incentive to conserve, whether the use is irrigation, municipal, or industrial. Accurate metering can also help to identify and quantify system losses. Most community water systems are metered. However, there are properties, such as city parks, golf courses, and cemeteries, which may not be metered.

WATER REUSE

One effective method of conserving existing water supplies is to establish a system of reuse. To some extent, current water supplies are reused as return flows from irrigation fields and effluent from wastewater treatment plants flows back into the natural waterways and aquifers. Many communities in the United States have safely and successfully used reclaimed wastewater for numerous purposes, including:

- Landscape irrigation: reclaimed sewage effluent can be used to irrigate parks, golf courses, highway medians and residential landscapes.
- Industrial process water: industrial facilities and power plants can use reclaimed water for cooling and other manufacturing processes.
- Wetlands: reclaimed water can be used to create, restore and enhance wetlands.
- Commercial toilet flushing: reclaimed water can be used to flush toilets in industrial and commercial buildings including hotels and motels.

No direct reuse of wastewater for drinking water use has been attempted in the United States, except in emergency situations. However, reuse of wastewater for industrial, agricultural and other uses such as golf course watering is becoming more common. In the future, water reuse may become a more valuable tool in meeting our future water needs.

The Division of Water Quality regulates water reuse in Utah. The rules and conditions under which wastewater can be reused is set forth in Title R317-1-4 of the Utah Administrations Code. Currently there are no reuse projects in the Bear River Basin.

The appropriateness of any individual reuse project will depend upon the effect that it will have on existing water rights. Often, downstream users depend upon the wastewater effluent to satisfy their rights. The effects on downstream water rights need to be addressed as part of the feasibility of any reuse project.

In some parts of the world, rainwater is collected and used to water lawns and garden areas. In some instances, even gray water (household water from tubs and sinks but not toilets) is collected for use outdoors. These rather extreme forms of water conservation may one day have an application in the basin, but at the present time water supplies are abundant enough and inexpensive enough to render these approaches economically unviable. At the present time and given the present cost of water, a collection system for either rainwater or gray water would, by far, exceed the cost of the water saved.

CONJUNCTIVE USE OF SURFACE AND GROUND WATER SUPPLIES

In areas where available water resources have been nearly fully developed, optimal beneficial use can be obtained by conjunctive use of surface water and ground water supplies. This involves carefully coordinating the storage, timing, and delivery of both resources. Surface water is used to the fullest extent possible year round, while ground water is retained to meet demands when streamflows are low.[4] Generally, the total benefit from a conjunctively managed basin will exceed that of a basin wherein the resources are managed separately. Additional benefits of conjunctive use may include:[5] better management capabilities with less waste; greater flood control capabilities; greater control over surface reservoir releases; and more efficient operation of pump plants and other facilities.

In evaluating alternatives for conjunctive use, water managers should view ground water as more than a supplement to surface suppliers. In particular, managers should assess the value of ground water in optimizing storage capacity, enhancing transmission capabilities, and improving water quality of the system.

AQUIFER STORAGE AND RECOVERY

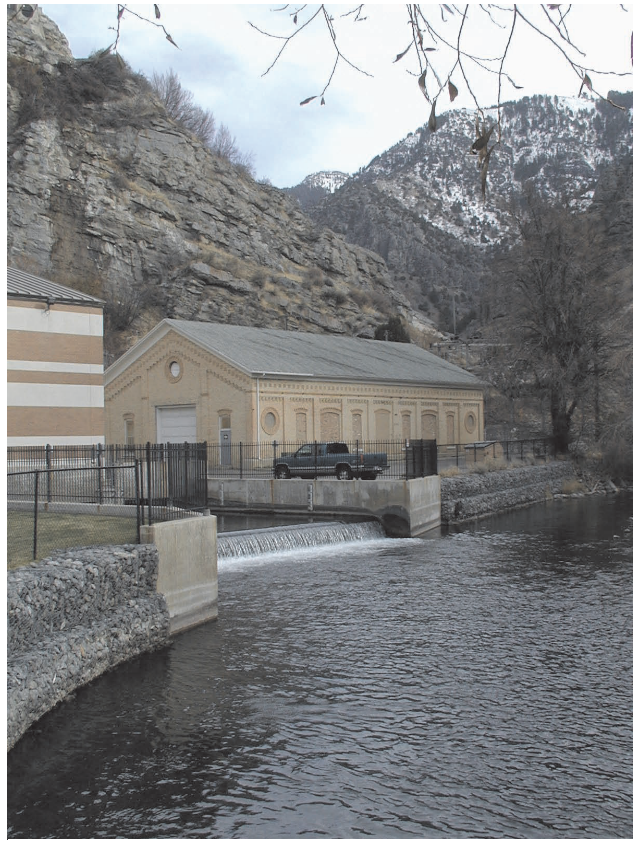
Another possible means of developing surface water and storing it for future M&I use is aquifer storage and recovery (ASR), also known as artificial ground water recharge. The approach with ASR is to use a primary ground water aquifer to store water supplies. Some utilities use ASR to store treated surface water during periods of low water demand, and provide the recovered water later to meet peak daily, short-term or emergency demands. Many communities have found ASR systems to have numerous advantages. These include[6] :

- Enhanced reliability of existing water supplies as aquifer storage provides a back-up supply during emergencies such as chemical spills or broken pipelines.
- Increased flows in streams to support fish, riparian habitat, and aesthetic purposes during periods of low summer flow.
- Decreased evaporation and vulnerability to contamination.

Aquifer storage and recovery requires minimal structural elements and has the ability to convey water from the point of recharge to any point of use near the aquifer without the extensive canals, piping and appurtenances. Aquifers also provide a water quality benefit since they have a natural ability to filter sediment and remove some biological contaminants. Unit costs for ASR facilities average about $400,000 per million gallons per day (mgd) or $360 per acre-foot per year.

To maintain ground water quality, it is necessary to treat surface water to drinking water standards before injecting it into a primary drinking water aquifer. Any entity using ASR is required to comply with regulations established and administered by the Division of Water Quality. They also need to file water right applications with the Division of Water Rights.

Brigham City initiated a pilot study ASR program in 1998. The program proved very successful and has continued since that time. Brigham City's primary water source consists of six springs in Mantua. The water from these springs is collected and delivered by pipe to the town of Brigham City about three and a half miles down canyon. During the winter months the flow from the springs exceeds the towns water needs. The excess flow during the winter season is chlorinated and injected into the local ground water aquifer. This chlorination provides some conditioning of the poor quality native ground water, increasing its value for M&I use. This is a great secondary benefit of the ASR project. At the present time Brigham City injects about 1.5 million gallons per day (4.6 acre-feet/day) for 180 days. During the summer, months the city then withdraws 800 gallons per minute (3.5 acre-feet /day) from the aquifer. Because the collection and delivery system was already in place, the project was started with a relatively low capital cost of about $165,000. There may be other opportunities in the basin for ASR to enhance M&I supplies, particularly in the Box Elder County area.



Logan City Power Plant

Cooperative Water Operating Agreements

Temporary localized water shortages may occur as the result of system failures or as a result of growth that approaches the limits of the water system or supply. A cooperative approach to water resource and system management at the local and regional level can help water managers prevent shortages better and cope with them if they do occur. This is often accomplished without committing the large sums of money to capital expenditures for new supplies that would otherwise be required. In its simplest form, adjoining water systems are interconnected and an agreement is made regarding the transfer of water between them.

Some of the many benefits to water suppliers who cooperatively operate their water systems in this way are:

- Greater flexibility in meeting peak and emergency water demands.
- Better scheduling options associated with regular maintenance and repair programs.
- Decreased capital costs as construction of new projects can be delayed.
- Increased opportunities for joint improvement projects as cooperative relationships are formed and resources more fully utilized.

At an institutional level, the manager of the cooperating systems must agree on such things as water transfer strategies, plans for interconnections, water conservation enforcement policies, and emergency management plans. Perhaps the most significant institutional challenge is to remove the psychological hurdle of taking water from one system and giving it to another. To do this, education of the public on the concept and benefits of a regional, cooperative approach to system management will often be necessary. The Utah Division of Drinking Water is working towards this goal by helping small local water systems consolidate their water treatment operations.

NOTES

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